M17833X

Utilator

KAY ELECTRIC COMPANY

OPERATING
AND MAINTENANCE MANUAL

ISSUE B

Utilator

CENTRAL ENGINEERING
INSTRUMENT POOL

KAY ELECTRIC COMPANY

MAPLE AVENUE • PINE BROOK, N. J. • CAPITAL 6-4000

COPYRIGHT, KAY ELECTRIC CO., 1961

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_05628

TABLE OF CONTENTS

Paragraph *Page*

SECTION I, FUNCTION & DESCRIPTION

1-1 Introduction..... 1
1-2 Specifications..... 1
1-3 Tube Complement..... 1
1-4 Equipment Supplied..... 1

SECTION II, INSTALLATION

2-1 General Instructions..... 2
2-2 Interconnection Data..... 2
2-3 Identification of Operating Controls..... 2

SECTION III, OPERATION

3-1 General Instructions..... 4
3-2 Measuring Frequency Response..... 4
3-3 Using the Utilator as a Marker Generator..... 5
3-4 Using the Utilator to Determine the Frequency of an Unknown Signal Source.... 5

SECTION IV, CIRCUIT DESCRIPTION

4-1 Overall Description..... 7
4-2 Automatic Gain Control Circuits..... 7

SECTION V, MAINTENANCE

5-1 Trouble-Shooting..... 8
5-2 Calibration Procedure..... 9

SECTION VI, LISTING OF REPLACEABLE PARTS

6-1 Introduction..... 11
6-2 Parts List..... 11

LIST OF ILLUSTRATIONS

Figure *Page*

1-1 Utilator.....facing 1
3-1 Interconnection Diagram for Measuring the Frequency Response of a Circuit.... 4
3-2 Interconnection Diagram for Using the Utilator as a Marker Generator..... 5
3-3 Interconnection Diagram for Determining the Frequency of an Unknown Signal Source..... 6
4-1 Functional Block Diagram..... 7
5-1 Voltage Measurements, Utilator..... 9
6-1 Utilator Schematic, KC-5446-G..... 13

Fig. I-1, UTILATOR

SECTION I
FUNCTION AND DESCRIPTION

I-1 INTRODUCTION.

The UTILATOR is a compact C-W utility oscillator, which provides continuous coverage between 4.5 and 220 mc in six switched ranges. The direct-reading frequency dial is calibrated to ± 1% and the amplitude of the high-level c-w output is held constant within ± 0.5 db over the range by agc. A built-in precision step-attenuator and metered output permit accurate quantitative measurements. The instrument is normally furnished complete in a metal cabinet, with built-in power supply.

I-2 SPECIFICATIONS.

Frequency Range: 4.5 to 220 mc, C-W; fundamental frequency.

RF Output: At least 0.7 volt rms (metered) into nominal 70 ohms (50 ohms on request). Typical units set at 1.0 rms maximum.

Flatness: ± 0.5 db over entire range; AGC'd.

Frequency Calibration: Direct-reading frequency dial, calibrated to within ± 1%.

Attenuators: Switched steps of 6 db, 10 db, 20 db and 20 db, plus a continuously variable 6-db increment.

Power Supply: Input approximately 60 watts, 117-V (±10%), 60 cps.

Physical Data: Dimensions– 11"W x 8½"H x 6½"D.
Weight– 19 lbs.

I-3 TUBE COMPLEMENT.

TYPE	QUANTITY
6AU6	2
6BK7	1
5718	2
5Y3	1
OB2	1

SEMI-CONDUCTORS

G7C silicon diodes	2
1N537 germanium diodes	1

I-4 EQUIPMENT SUPPLIED.

Utilator

Instruction Manual

SECTION II
INSTALLATION

2-1 GENERAL INSTRUCTIONS.

The UTILATOR contains its own power supply and is readily portable, thus presenting no special installation problems. To insure optimum performance, the instrument should not be subjected to unusual environmental conditions, such as, exposure to excessive moisture, vibration, or temperatures. The installation should include provision for connection to the auxiliary equipment, to the circuit under test and to a source of 117 volts, 60 cps power.

2-2 INTERCONNECTION DATA.

Output impedance of the UTILATOR is a nominal 70 ohms (50 ohms on request). If the input impedance of the equipment under test matches this value, connection can be made directly between the OUTPUT jack on the UTILATOR and the input of the tested device. Where impedance match is important, and the input impedance of the tested circuit differs substantially from 70 ohms, an impedance matching device must be used. Interconnection between the equipment should be made with coaxial cable having proper impedance. All leads should be kept as short as possible, consistent with placement of equipment on the bench.

2-3 IDENTIFICATION OF OPERATING CONTROLS.

CONTROL	POSITION	FUNCTION
ON - OFF Switch S-1	ON	When this switch is set to the ON position, power is applied to transformer T-1 in the power supply section, energizing the instrument for operation.
	OFF	When S-1 is in the OFF position, the instrument is completely de-energized.
Band Selector Switch S-2	6 bands	The outer knob of the concentric frequency control is used to select the desired range of frequencies.
Frequency Control Capacitor C-3A,B	Variable	This is the inner concentric control and is used to vary the output frequency within the range selected by the Band Selector.
Attenuator Switches S-3 thru S-6	4 steps	The C-W output available at J-1 can be attenuated in precise steps by appropriately setting these switches.
RF LEVEL pot. R-9	Variable	This control provides a continuously variable 6-db increment of attenuation, in addition to the fixed steps.

CONTROL	POSITION	FUNCTION
Meter Adjust pot. R-12 (int.)	Variable	Potentiometer R-12 is located at the rear of the chassis and is used to calibrate the meter.
A.G.C. Adj. pot. R-8 (int.)	Variable	R-8 (located on rear of chassis) is used to set the Output Level.
6 DB Adj. pot. R-46	Variable	R-46 (located on rear of chassis) is used to set the 6 db range of the RF LEVEL control.
Meter M-1	--- ---	This is a calibrated 0 - 1.2 volt meter which continuously measures the cw signal at the input of the attenuator.
RF OUT Jack J-1	--- ---	This is a BNC-type female connector located on the front panel.

SECTION III
OPERATION

3-1 GENERAL INSTRUCTIONS.

Since a cw signal generator of this type is such a universal instrument, having a large number of applications, only very general instructions will be included in this manual along with a particular applications which may be used as illustrations. There are many good textbooks which cover the uses of signal sources and anyone interested is advised to consult them.

Step 1 - Turn the UTILATOR and associated equipment on and allow a 15-minute warm-up period to temperature-stabilize the circuits.

Step 2 - Set the Band Selector to the desired frequency range and adjust the Frequency control to the specific frequency desired.

Step 3 - Adjust the RF LEVEL control for the desired amplitude of c-w output, as indicated by the UTILATOR meter. If the gain is too high, stepped attenuation can be inserted by placing the appropriate attenuator switches in the "up" position.

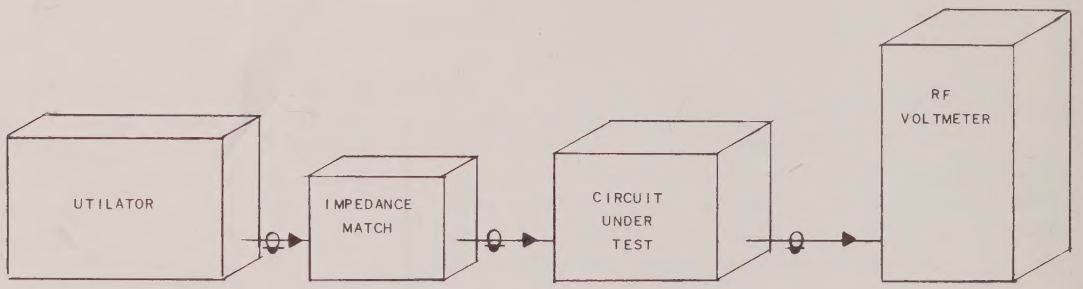


Fig. 3-1, Interconnection Diagram for Measuring the Frequency Response of a Circuit.

3-2 MEASURING FREQUENCY RESPONSE.

Step 1 - Connect the equipment as shown in Fig. 3-1. The impedance matching device is necessary only if the impedance of the circuit being measured differs substantially from the impedance of the UTILATOR. It is necessary that the voltmeter being used is accurate in the frequency range covered by the circuit being measured.

Step 2 - Set the frequency of the Utilator at the lower end of the passband of the circuit being measured. Record the reading of the voltmeter.

Step 3 - Increase the frequency of the UTILATOR by any desired increment. Record the reading of the voltmeter at this point.

Step 4 - Continue increasing the frequency of the UTILATOR, making voltage readings at each increment, until the upper end of the passband of the circuit being tested is reached. If desired, a graph can now be made showing the frequency response of the circuit being measured.

3-3 USING THE UTILATOR AS A MARKER GENERATOR.

Connect the equipment as shown in Fig. 3-2. The connection between the detector and the scope need not be coaxial cable. As in all applications, the impedance matching device is only necessary when the impedances of the equipment being used differ widely. If the circuit under test employs a detector in its output circuit, the UTILATOR will have to be connected to the input of the circuit under test.

When used in this manner, the UTILATOR can supply a good bit of useful information. The passband of the equipment can be measured. The frequencies at which peaks and valleys occur can be measured. The frequencies at which distortions occur can be measured. Many other uses for the UTILATOR in this application will probably be found by the operator as he becomes more adept at handling the equipment.

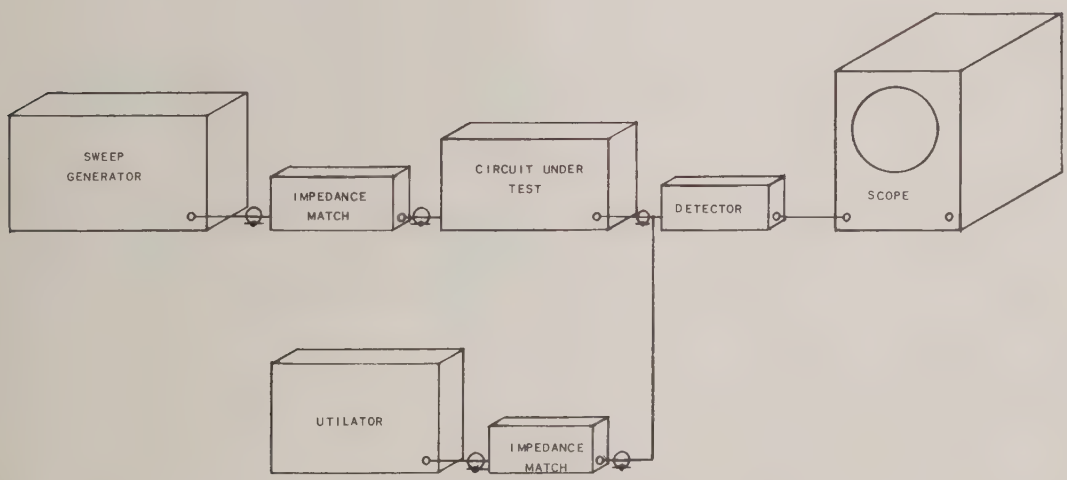


Fig. 3-2, Interconnection Diagram for Using the Utilator as a Marker Generator.

3-4 USING THE UTILATOR TO DETERMINE THE FREQUENCY OF ANY UNKNOWN SIGNAL SOURCE.

Step 1 - Connect the equipment as shown in Fig. 3-3. As in all applications, the connection between the impedance matching device and the scope need not be coaxial cable, and the impedance matching device is only necessary when the impedance of the unknown signal source differs substantially from the impedance of the UTILATOR.

Step 2 - Set the frequency of the UTILATOR to the supposed approximate frequency of the unknown signal source.

Step 3 - Search for the frequency of the unknown signal source by varying the frequency of the UTILATOR above and below the original setting.

Step 4 - As the frequency of the unknown source is approached, the output of the impedance matching device (which will be the difference frequency and the sum frequency of the two sources, the difference frequency being the only one which concerns us here) will come into range of the bandwidth of the scope. When the signal is in the bandwidth of the scope, an output will appear and increase in output as the difference frequency gets lower. When the difference frequency becomes zero, the output shown on the scope will collapse (null point). At this point, the frequency reading on the UTILATOR will give the frequency of the unknown signal source. If the unknown signal source is sharply tuned, the UTILATOR will have to be varied very slowly to avoid tuning through the frequency of the unknown signal source without noticing the output indication of the scope.

Step 5 - The UTILATOR should be tuned to multiples of the null frequency in order to avoid selection of a harmonic frequency. The signal which gives the most output just before reaching the null point indicates the correct frequency.

This method can also be used for calibrating an unknown signal source, if the source is variable.

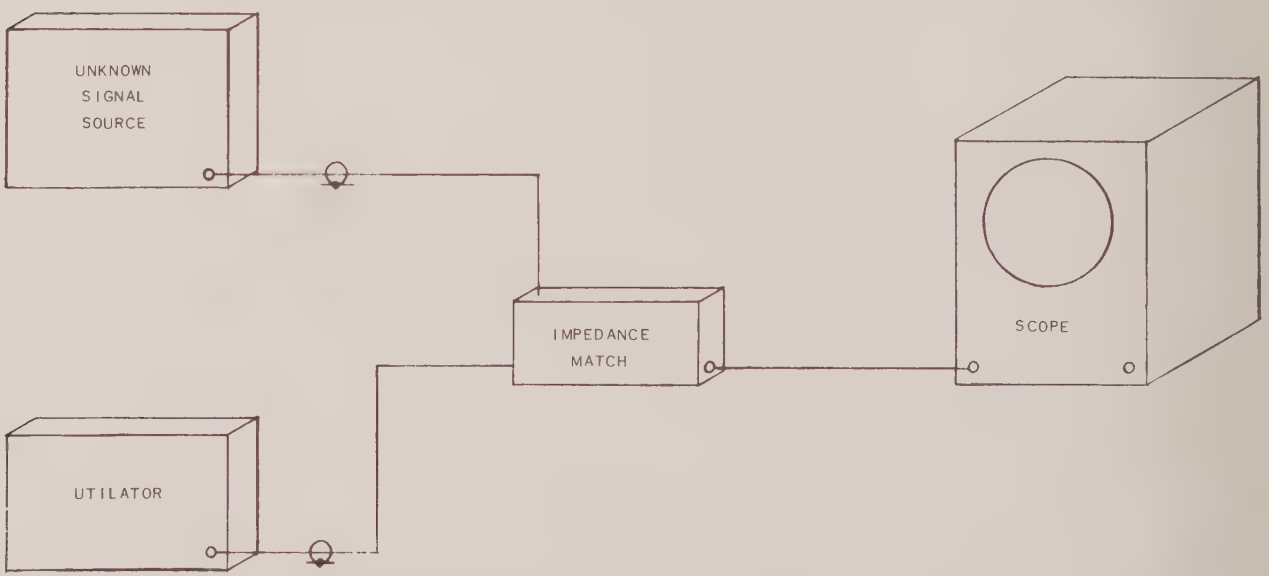


Fig. 3-3, Interconnection Diagram for Determining the Frequency of an Unknown Signal Source.

SECTION IV
CIRCUIT DESCRIPTION

4-1 OVERALL DESCRIPTION.

The UTILATOR circuitry consists basically of a plate-tuned, push-pull oscillator, special agc circuit to keep the oscillator output constant, and stepped and variable attenuation to permit adjustment of output amplitude. Fig. 4-1 The plate tank coils (L-1B, L-2B, etc.) are switched into the plate circuit of the oscillator (V-5, V-6) as the Band Selector switch (S-2) is rotated. Continuous tuning within the range of the selected band is provided by capacitor C-3A and B. Agc'd plate voltage is applied to the center-tap of the plate tank coils to maintain oscillator output constant.

4-2 AUTOMATIC GAIN CONTROL CIRCUITS.

A sample of the r-f output is fed to two high frequency diodes, D-1 and D-2, which are used in a voltage-doubler detector circuit. The detected negative output sample voltage is d-c coupled to the agc amplifiers V-2 and V-3. Cathode follower output tube V-4 supplies the agc'd voltage to the plates of the oscillators V-5 and V-6.

The detected output sample voltage taken from the voltage-doubler detector is then d-c coupled to the grid of V-2 and amplified. (The settings of R-8 and R-46 determine the average grid bias for V-2 and eventually, the average plate potential for V-5 and V-6, and therefore the r-f output level.) The second agc amplifier, V-3, has its grid tied directly to the plate of V-2, the first agc amplifier, and further amplifies the error voltage.

The cathode follower output tube, V-4, derives its grid bias by direct coupling to the plate of V-3. The error voltage applied to the agc input tube, V-2, appears at the cathodes of V-4, greatly amplified; the cathodes of V-4 and therefore, the plates of the oscillators, V-5 and V-6, follow the error voltage and maintain the oscillator output constant.

Diode D-3 in the plate circuit of V-3 is a limiter which prevents the plate voltages of the oscillators from rising to levels which would be harmful to them when the load is removed, as when the UTILATOR is being switched to another band.

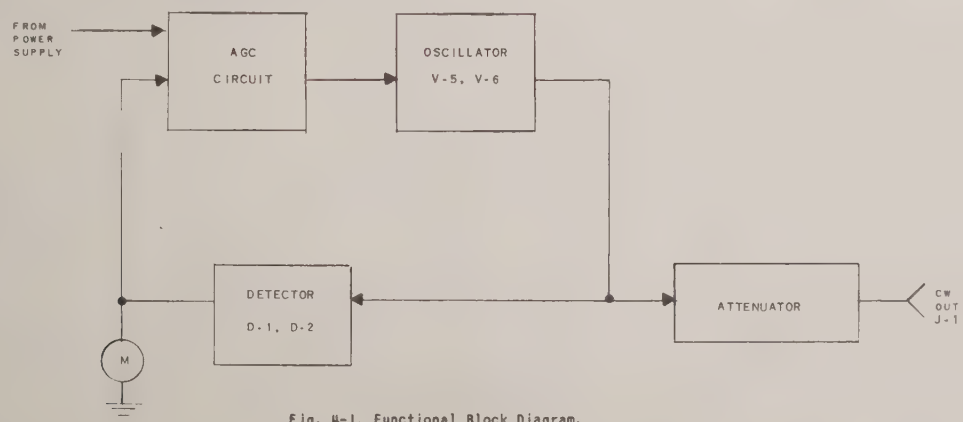


Fig. 4-1, Functional Block Diagram.

SECTION V
MAINTENANCE

5-1 TROUBLE-SHOOTING.

If operation of the UTILATOR appears to be defective in any respect, first determine that the cause of the trouble is not in the circuit under test or in the interconnecting cables. If a process of elimination indicates that the trouble originates in the UTILATOR, continue the diagnosis by attempting to determine which circuit is malfunctioning. Preliminary visual inspection should include:

Step 1 - Determine that all tubes are fully seated in their respective sockets and all filaments are lit.

Step 2 - Inspect fuse F-1 for open circuit, or intermittent contact within the fuse holder.

Step 3 - Check for B+ voltage at the junction of R-22 and C-12D. Approximate voltage values are shown on the schematic.

If inspection proves that conditions covered in steps 1 through 3 are in order, continue the inspection by considering the symptoms and possible causes listed next.

SYMPTOM	POSSIBLE CAUSE
a. Line fuse blows instantly when power switch is turned on.	Defective rectifier (V-7). Shorted filter capacitor (C-12, 13, 14).
b. No B+ voltage.	Defective transformer T-1. Electrical short to chassis.
c. No c-w output on any one or all ranges, but conditions of a and b do not exist.	Open C-7. Open R-25, R-26, etc. Defective V-4, V-5 or V-6.
d. No reading on output meter, but conditions a thru c do not exist.	Open or shorted diode D-1, D-2. Open C-11. Defective meter.
e. RF output low and not constant in amplitude.	Faulty V-2.
f. RF output high and not constant in amplitude.	Faulty V-3.

TABLE 5-I, VOLTAGE MEASUREMENTS FOR THE UTILATOR

NO.	TUBE	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9
V-1	0B2	100	0		0	100		0		
V-2	6AU6	-0.45	0	6.3VAC	6.3VAC	24	10	0		
V-3	6AU6	24	25	6.3VAC	6.3VAC	150	100	25		
V-4	6BK7	315	130	130	6.3VAC	6.3VAC	315	150	130	0
V-5	5718	-15*		6.3VAC		0	6.3VAC		130+	
V-6	5718	-15*		6.3VAC		0	6.3VAC		130+	

*THIS READING VARIES BETWEEN APPROXIMATELY -10 AND -20 VOLTS, DEPENDING UPON WHICH BAND IS BEING USED.

+THIS READING VARIES BETWEEN APPROXIMATELY 100 AND 150 VOLTS, DEPENDING UPON WHICH BAND IS BEING USED.

5-2 CALIBRATION PROCEDURE.

The UTILATOR should give trouble-free service over long periods of time without the requirement for readjustment of circuit components. However, normal aging of tubes and components may necessitate the recalibration of output frequency and output meter. The accuracy of recalibration will depend on the accuracy of test equipment used and the accuracy with which the measurements are made.

EQUIPMENT REQUIRED:

(1) Frequency standard (accurate signal generator or crystal calibrator).

(2) R-F voltmeter, capable of handling the above frequencies.

CHECK-OUT OF OSCILLATOR FREQUENCY:

Step 1 - Turn the UTILATOR on and allow a 15-minute warm-up period.

Step 2 - Set the Band Selector switch to the first range (4.5 - 8 mc). Set the RF LEVEL control fully clockwise. Set the Frequency control (C-3) to 4.5 mc.

Step 3 - Heterodyne the frequency standard with the UTILATOR at 4.5 mc; a beat should result.

Step 4 - Set the Frequency control on the UTILATOR to 8 mc and tune the frequency standard; again a beat should occur. Intermediate points between 4.5 and 8 mc should also be checked.

Step 5 - If the above checks disclose that the range is out of calibration, oscillator frequency can be shifted by spreading or compressing the coil turns of L1-B. Spreading the turns will lower the inductance and raise the frequency, or conversely, compressing the turns will increase the inductance and lower the frequency.

Step 6 - Continue the procedure for the remaining ranges, using the technique described in steps 1 thru 5. *Note* – Extreme care should be exercised when coil turns are adjusted to avoid damage to the coil or to the bakelite rod on which the coil is wound. Since the coil turns are cemented in place, a suitable solvent should be used to loosen the cement prior to any attempt to adjust the turns.

CHECK-OUT OF OUTPUT LEVEL AND METER CALIBRATION.

Step 1 - Set the RF LEVEL control fully clockwise (maximum output). Set the Band Selector to the first range (4.5 – 8 mc).

Step 2 - Terminate the OUTPUT jack (J-1) with 70 ohms, and connect the RF voltmeter to J-1.

Step 3 - Vary the Meter Adjust control (R-12), located on rear of the chassis, until M-1 reads the same as the external RF voltmeter.

Step 4 - Set the Frequency control to 8 mc. The meter readings should not change by more than 0.5 db.

Step 5 - Two controls are available to set the RF LEVEL control range. These controls are located on the rear of the instrument. The AGC Adj control (R-8) should be set to give between 0.7 and 1 volt output when the RF LEVEL control is turned fully clockwise. The 6 DB ADJ control should be adjusted to give 0.5 volt output when the RF LEVEL control is turned fully counterclockwise. These controls have some interaction making it necessary to repeat these adjustments several times.

Step 6 - Switch the Band Selector to each of the remaining ranges, tuning the Frequency control through each range, to determine that the output amplitude remains constant within ±0.5 db.

Step 7 - If the output on any one range falls below the 0.5 db limit, it indicates that the oscillator output on this band is below the agc clamping point. Raising the value of the resistor shunting the tank coil (R-48 thru R-53), or increasing the output coupling by compressing the turns of the pick-off loop (wound over the tank coil) will increase the oscillator output. The oscillator is adjusted properly when the output, as noted on the output meter, lowers as the RF LEVEL control is turned counterclockwise, and it remains constant when tuning the Frequency control through its range.

If when turning the RF LEVEL control counterclockwise a sudden increase in output is noticed, it indicates that the oscillator output is too strong. (This control should have a 6 db range). The shunt resistor should be lowered or the pickoff loop spread.

SECTION VI
REPLACEABLE PARTS LIST

6-1 INTRODUCTION.

This parts list covers all replaceable component parts for the UTILATOR. Unless otherwise specified, all resistors are fixed composition, ½ watt, 10% tolerance; all capacitors are in μμf, 500 volts. Those components which are factory selected for specific values, are so noted in the parts list.

It is suggested exact replacement parts be used when repairs are made on the UTILATOR, exact replacements are available from the factory when reference is given to the instrument model number and serial number. Replacement part orders should also reference the circuit symbol number to avoid misinterpretation of the requirement.

6-2 UTILATOR PARTS LIST (Schematic KC-5446-G).

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
	Capacitors: (All capacitors in μμf, 500 volts, unless otherwise indicated.)	
C-1 & C-2	0.01μf, ceramic disc	6360-6
C-3A, B	3–22.5, dual variable	5441
C-4	0.001μf, 75V, ceramic disc	6360-1
C-5 & C-6	10, ceramic, tubular	6361-28
C-7 thru C-9	0.01μf, ceramic disc	6360-6
C-10	0.004μf, ceramic disc	6360-3
C-11	0.02μf, ceramic disc	6360-7
C-12A, B, C, D	20/20/20/20μf, 475V, electrolytic	6355-8
C-13 & C-14	4000, ceramic feed thru	6356-5
C-15	0.001μf, 75V, ceramic disc	6360-1
C-16 thru C-19	0.75, ceramic tubular	6361-37
C-20	0.01μf, ceramic disc	6360-6
C-21 & C-22	4000, ceramic feed thru	6356-5
D-1 & D-2	Diode, silicon, G7C	6357-4
D-3	Diode, germanium, 1N537	6357-6
F-1	Fuse, 3 amp, 250V	245
I-1 & I-2	Lamp, indicator, Bayonet #44	249
J-1	Jack, UG-185/U	204
L-1 A, B	Coil, special	L1/5446G
L-2 A, B	" "	L2/5446G
L-3 A, B	" "	L3/5446G

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
L-4 A,B	Coil, special	L4/5446G
L-5 A,B	" "	L5/5446G
L-6 A,B	" "	L6/5446G
L-7	Not used	
L-8 & L-9	Coil, choke, 12μh	6394-1
L-10 & L-11	" " .8μh	6394-3
M-1	Meter, 200μa	6998
P-1	Plug, a-c line cord	328
	Resistors: (Unless otherwise specified, all components are fixed composition, ½ watt, 10% tolerance resistors.)	
R-1 & R-2	47 K, 2 watt	4731-H
R-3	150 K	1541-E
R-4	15 K	1531-E
R-5	2.7 M	2751-E
R-6	680 K	6841-E
R-7	1.2 M	1251-E
R-8	1.0 M, 2 watt pot, variable	130
R-9	50 K, 2 watt pot, variable	117
R-10	10 K, 2 watt pot, variable	108
R-11	12 K	1231-E
R-12	180	1811-E
R-13	3.9 M	3951-E
R-14	51 K, 5% tolerance	5135-E
R-15	12 K	1231-E
R-16	27	2701-E
R-17	27	2701-E
R-18 & R-19	15 K, ¼ watt	1531-C
R-20	1 K, ¼ watt	1021-C
R-21	100 K, ¼ watt	1041-C
R-22	1 K, 2 watt	1021-H
R-23	100	1011-E
R-24	68	6801-E
R-25 thru R-30	330	3311-E
R-31 & R-32	85.6, ¼ watt, 1% tolerance	6558-25
R-33	345, ¼ watt, 1% tolerance	6558-41
R-34 & R-35	85.6, ¼ watt, 1% tolerance	6558-25
R-36	345, ¼ watt, 1% tolerance	6558-41
R-37 & R-38	134.8, ¼ watt, 1% tolerance	6558-31
R-39	100, ¼ watt, 1% tolerance	6558-26
R-40 & R-41	212, ¼ watt, 1% tolerance	6558-35
R-42	52.1, ¼ watt, 1% tolerance	6558-18
R-43	330 K, 1 watt	3341-G
R-44	680 K	6841-E
R-45	470 K	4741-E
R-46	25 K, 2 watt pot, variable	113
R-47	Not used	
R-48 thru R-53	Factory selected	

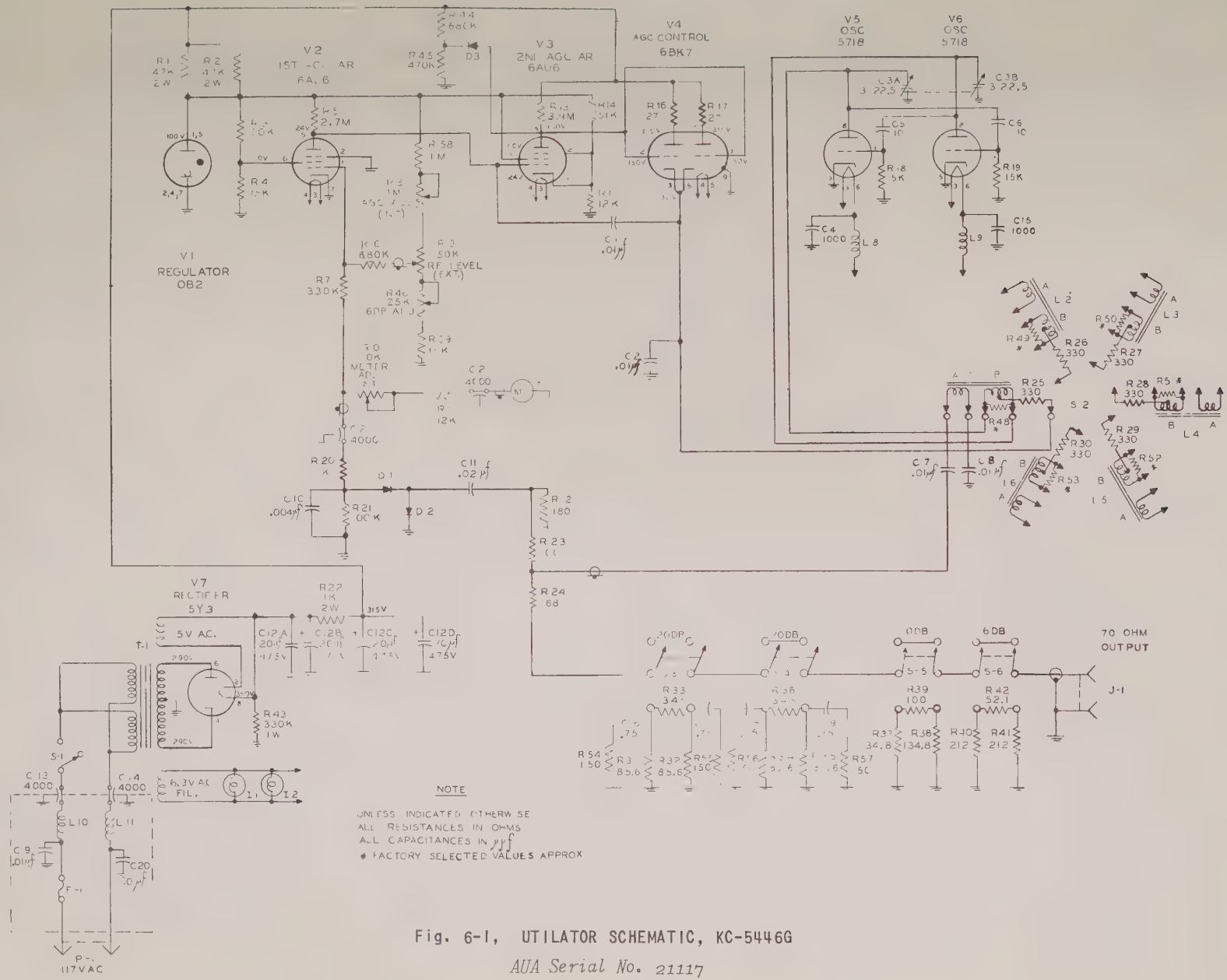
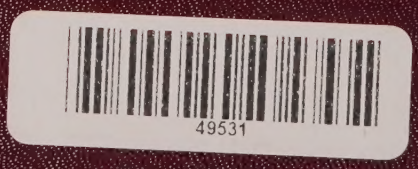


Fig. 6-1, UTILATOR SCHEMATIC, KC-5446G

AUA Serial No. 21117

DWG. SYMBOL NO.	DESCRIPTION	KAY PART NO.
R-54 thru R-57	150.2, ¼ watt, 1% tolerance	6558-59
R-58	1.0 M	1051-E
R-59	15 K	1531-E
S-1	Switch, toggle, SPST	255C
S-2	Switch, rotary, 6 position	5376
S-3 thru S-6	Switch, toggle, DPDT	254T
T-1	Transformer, power	5615
V-1	Tube, OB2	OB2
V-2	" 6AU6	6AU6
V-3	" 6AU6	6AU6
V-4	" 6BK7	6BK7
V-5	" 5718	5718
V-6	" 5718	5718
V-7	" 5Y3	5Y3
	Attenuator (complete)	5375
	Knob, large, for S-2	2961
	Knob, small, for S-2	2962
	Knob, dotted	165-D
	Plastic dial, blank	4822


49531